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Port Hueneme, California 93043-4370

TECHNICAL REPORT
TR-2084-SHR

BASIS OF DESIGN FOR THE HIGH PERFORMANCE MAGAZINE

by
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A new magazine design, named the High Performance (HP) Magazine, is being developed by the Naval Facilities Engineering Service Center (NFESC). The HP Magazine provides a better balance between operational requirements, explosives safety regulations, and economic considerations. The magazine is designed to meet explosives safety regulations within the many constraints imposed by public encroachment, shrinking supply of buildable land, especially near the waterfront, rising cost of land to accommodate ESQD distances, and reduced operating budgets to handle the many types, sizes, and classes of ordnance in today's Navy inventory. This paper is a Basis of Design Document to provide guidance in developing standard drawings and satisfying explosive safety regulations.

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EXECUTIVE SUMMARY

A new magazine design, named the High Performance (HP) Magazine, is being developed by the Naval Facilities Engineering Service Center (NFESC). The HP Magazine provides a better balance between operational requirements, explosives safety regulations, and economic considerations. The magazine is designed to meet explosives safety regulations within the many constraints imposed by public encroachment, shrinking supply of buildable land, especially near the waterfront, rising cost of land to accommodate ESQD distances, and reduced operating budgets to handle the many types, sizes, and classes of ordnance in today's Navy inventory. This paper is a Basis of Design Document to provide guidance in developing standard drawings and satisfying explosive safety regulations.

Table of Contents

Table of Contents

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this document is to present the basis of design (BOD) for the High Performance (HP) Magazine to meet applicable operational, explosives safety, and physical security requirements. The explosives safety siting criteria, which is being submitted in FY97 to the Naval Ordnance Center (NAVORDCEN) and the Department of Defense Explosives Safety Board (DDESB) for approval, is provided as a basis for determining blast design loads on the Shipping and Receiving Area (SRA) entrance door and the pit covers. The design agency will use this BOD to develop construction drawings and specifications.

1.2 BACKGROUND

The NFESC is developing a new magazine, named the High Performance (HP) Magazine, for more efficient storage of ordnance. The conceptual design of the HP Magazine is described in Figures 1-1 and 1-2. The HP Magazine reduces the land area encumbered by Explosives Safety Quantity Distance (ESQD) arcs by at least 80 percent; allows noncompatible ordnance to be stored in the same magazine, thereby reducing the number of magazines needed to store a fixed inventory of ordnance; requires a smaller work crew and less equipment and time to store and retrieve ordnance; provides the equivalent of a barricaded siding for temporary storage of ordnance loaded vehicles; improves storage efficiency, selectability and versatility; and accommodates a broad spectrum of ordnance types (i.e., missiles, mines, torpedoes, bombs, bullets, projectiles, etc.), ordnance sizes (i.e., containerized missiles and palletized conventional ordnance), and hazard classes of Navy ordnance. In general, the HP Magazine provides a better balance between operational requirements, explosives safety regulations, and economic considerations.

Improved operations are achieved in the HP Magazine with the use of a bridge crane (or cranes); a universal straddle carrier (USC) to allow crane transfer of multiple pallets, containers, or canisters; and a forklift to transfer ordnance to/from covered vehicles.

The most important factor in the improved explosives safety performance of the HP Magazine is the reduction in the Maximum Credible Event (MCE) to a fraction of the total quantity of explosives stored in the HP Magazine. For example, the explosive storage capacity of the basic HP Magazine is 300,000 pounds net explosive weight (NEW), but the MCE is no more than 60,000 pounds NEW. This performance is achieved by utilizing walls and moveable pit covers that are designed to prevent propagation of a detonation between storage or transfer areas.

NFESC initially developed and showed the feasibility of the HP Magazine concept using model analysis and explosive tests of small-scale and full-scale non-propagation walls (NPW). In FY93, NFESC conducted two full-scale explosive tests which demonstrated the explosives safety performance of the NPW's.

In FY95 and FY96, NFESC conducted two full-scale magazine tests (Certification Test 1 (CT1) and Certification Test 3 (CT3)) to certify explosives safety of the prototype design of the HP Magazine. These tests certified that the HP Magazine design prevents sympathetic detonation under the two most critical hazard scenarios. CT1 tested the MCE in a covered storage area (30,000 pounds) to obtain the maximum cell wall loading; CT3 tested the MCE in uncovered storage/transfer (60,000 pounds total in the SRA, the open storage cell, and the crane load) to obtain the greatest total loading on a storage cell. A certification test of the pit cover, Certification Test 2 (CT2), was conducted to certify the required cross-section of the pit cover for preventing fragment penetration.

Analytical modeling was used to certify the explosives safety of the prototype design for the MCE fires in either the SRA or a storage cell.

1.3 SCOPE

This BOD provides the architectural, structural, mechanical, electrical, siting, civil, and physical security requirements needed to design a HP Magazine. A separate Statement of Work and Basis of Design is being used by the Naval Packaging, Handling, Storage, and Transportation Center (PHSTC), Naval Weapon Station (NWS) Earle, Colts Neck, New Jersey, to develop the Universal Straddle Carrier (Ref. 1). A separate BOD (Ref. 2) has also been written to cover the HP Magazine Mechanical System (Bridge Crane and Pit Cover Operating System, PCOS) design and procurement. The UST design and the resulting Mechanical System designs shall be used with the requirements of this BOD to provide a complete standard design. Any departures from these requirements or conflicts with other compliance documents should be submitted to NFESC, Code ESC62, for review and approval.

1.4 DRAWINGS AND SPECIFICATIONS

Construction drawings, specifications, and design calculations shall be submitted to NFESC (Code ESC62) to review for compliance with requirements of this document. The design package shall be submitted to NFESC for 60 percent and 100 percent design reviews.

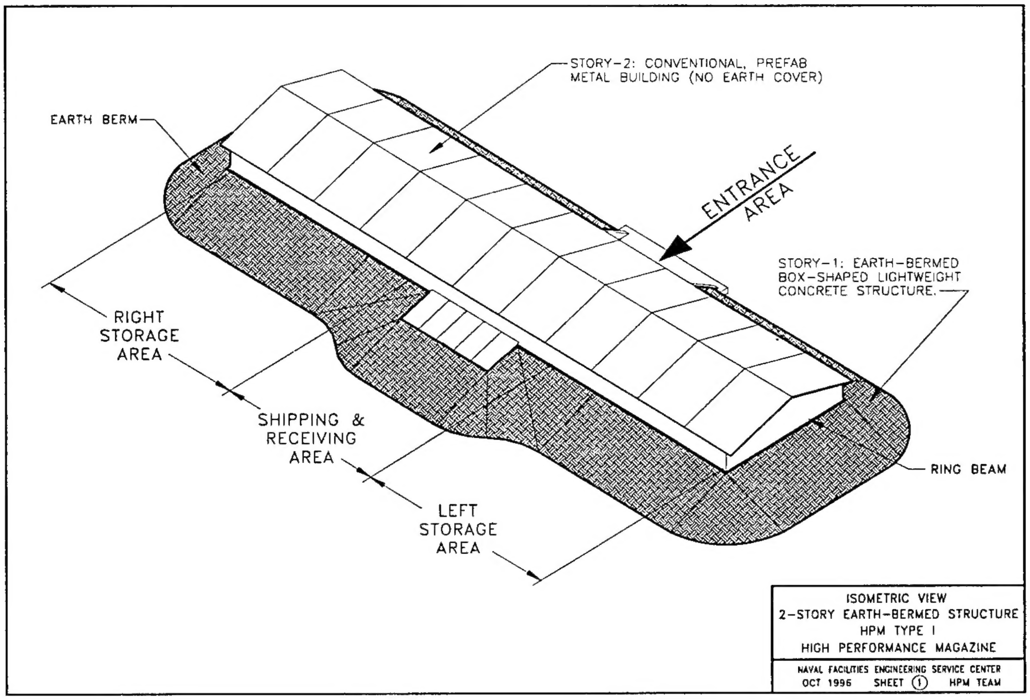


Figure 1-1. High Performance Magazine: Isometric view of magazine.

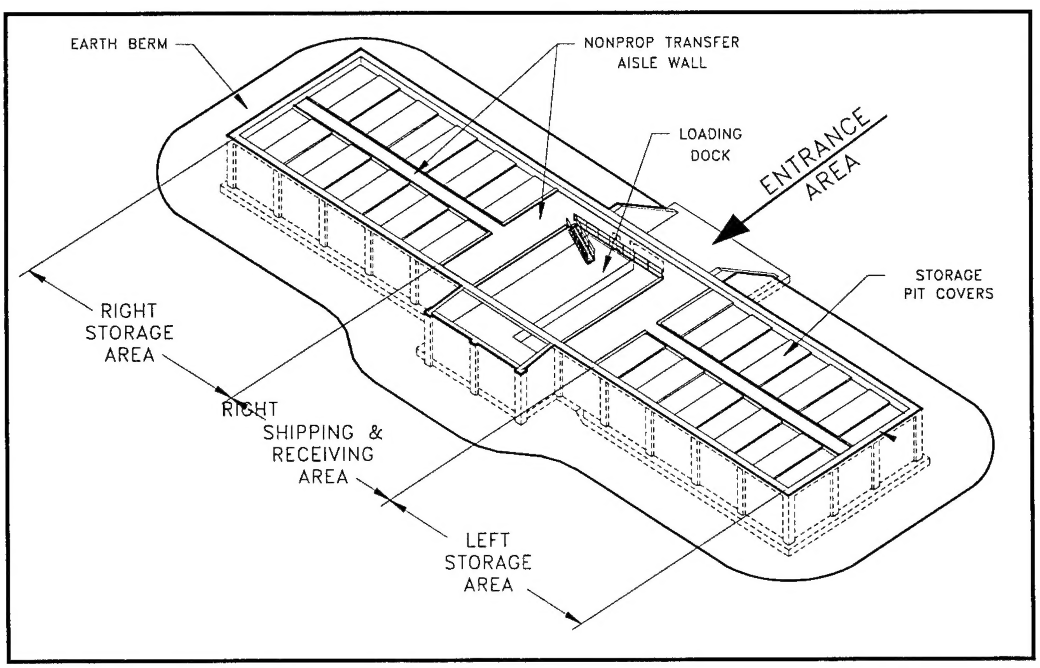


Figure 1-2. High Performance Magazine: Major areas of magazine.

2.0 SITING CRITERIA

2.1 GENERAL

The following sections specify the safe separation distance required from an HP Magazine, with respect to HP Magazine, inhabited building, public traffic route, and intraline distances. The safe separation distance is based on the formula, $D=KW^{1/3}$, where "D" is the safe separation distance in feet, "W" is the net weight of explosives in pounds, and "K" is a factor depending upon the degree of damage that is acceptable. The value of "K", depending on the orientation, construction, and function of the acceptor facility, in effect specifies the safe separation distance from an HP Magazine. Examples shown below are for the basic HP Magazine with a 60,000 pounds MCE (the MCE of an HP Magazine is considered the NEW for calculating safe distances). Other HP Magazines can be limited to a smaller MCE (such as an HP Magazine dedicated to missile storage which would have an MCE of 45,000 pounds)

2.2 INTERMAGAZINE DISTANCE (IMD)

IMD is expected to protect against the propagation of an explosion (detonation) of Class/Division 1.1 material between HP Magazines by sympathetic detonation. Based on the special construction details of an HP Magazine and the tested capability of an HP Magazine to prevent explosion communication between adjacent storage cells ($K < 0.5$ ft/lb$^{1/3}$) in the same HP Magazine, the IMD distances given below are expected to protect against the propagation of a detonation of Class/Division 1.1 materials from one HP Magazine to another. These IMD distances are consistent with values specified in NAVSEA OP-5 Safety Regulations for a standard earth-covered magazine.

Intermagazine distance between an HP Magazine and any other magazine can be determined by using the standard earth-covered magazine criteria in NAVSEA OP-5 with 60,000 pounds as the NEW in the HP Magazine.

2.3 INHABITED BUILDING DISTANCE (IBD)

The IBD is the safe separation distance required from an HP Magazine to an inhabited building. An inhabited building is any structure, other than an explosives operating building, that is used in whole or in part for human habitation or place of assembly. The IBD provides protection against serious injuries and death, and protects the building from substantial structural damage. The IBD from an HP Magazine is $K = 35$ in all directions. For example,

IBD = $KW^{1/3} = 35\ (60{,}000)^{1/3} = 1370$ feet, in any direction from an HP Magazine

2.4 PUBLIC TRAFFIC ROUTE (PTR) DISTANCE

The Public Traffic Route (PTR) distance is the safe separation distance required from an HP Magazine to the nearest public traffic route. The PTR is 60 percent of the IBD, or:

K = 0.60(35) = 21, in any direction from an HP Magazine
PTR = $21(60{,}000)^{1/3} = 822$ feet, in any direction from an HP Magazine with an MCE of 60,000

2.5 INTRALINE DISTANCE (ILD)

The Intraline Distance (ILD) is the safe separation distance required from an HP Magazine to an explosives operating building. ILD provides protection against the propagation of an explosion from an HP Magazine to an explosives operating building. The ILD from an HP Magazine may be considered the same as for a standard earth-covered magazine as provided in NAVSEA OP-5. See NAVSEA OP-5 Table 7-12.

Table 2-1. Intermagazine Distances between HP Magazines

	K(ft/lb$^{1/3}$)			D(ft)[c]		
To / From	Front	Side	Rear	Front	Side	Rear
Front	2.75[a] 11[b]	2.75[a]	2.75[a]	108[a] 430[b]	108[a]	108[a]
Side	2.75[a]	1.25	1.25	108[a]	49	49
Rear	2.75[a]	1.25	1.25	108[a]	49	49

Notes:
a When the entrance headwall (SRA wall and door without an earth berm) of HP Magazine A is outside the 120-degree section of HP Magazine B, but the headwall of HP Magazine B is inside the 120-degree sector of HP Magazine A.
b When the entrance headwall (SRA wall and door without an earth berm) of both HP Magazines are within the 120-degree sector of each other.
c Based on W = 60,000 pounds NEW for HP Magazine

3.0 CIVIL

3.1 SITE GRADING

Finished floors of the storage areas shall be five and a half feet below existing ground with the site graded away from all facilities. This reduces the soil needed for the earth berm and provides earth fill for the berm. Floor elevations with respect to the storage cell floor are shown in Figure 4-2. The ground surface inside the fence line shall be flat and free of vegetation. Variations are allowed in floor elevations with respect to existing grade, if the slope into the SRA is kept within the capability of the transfer vehicles and the relative elevations of all internal floors and walls are equal to those shown in Figure 4-2.

3.2 WATER DRAINAGE SYSTEM

The access road to the magazine may slope into the magazine. Drainage must be designed to prevent ponding of water in the magazine or the entrance area.

3.3 EROSION CONTROL

The slope of magazine earth-cover and any earth barricades shall be 1.5:1. The earth slope shall be protected for long-term slope stability and erosion control. The slope shall not be protected by a bituminous surface or any other flammable coating.

3.4 FENCING

Security fencing shall surround the Weapons Station. Security fencing shall be grounded, as specified in Section 7.0 of this report. Security fencing with traffic gates shall isolate the magazine to control the flow of personnel.

3.5 ROADS

All roads, truck pads, and vehicle parking areas servicing magazine shall be paved surfaces designed for truck loads. The paved roads shall be at least 12 feet wide. The road approaching the entrance area of the magazine shall have a maximum slope of 2 percent.

3.6 OPENINGS

All openings and penetrations in exterior walls of the HP Magazine shall be designed to protect interior spaces from the outside environment.

4.0 ARCHITECTURAL.

4.1 GENERAL

The HP Magazine is an earth-bermed, 2-story, box-shaped structure. Story - 1 is a reinforced concrete structure for ordnance storage. Story-2 is a lightweight metal structure that provides environmental protection and the space for crane transfer of ordnance. Story-1 consists of lightweight concrete walls with an external earth-berm to an elevation 3 feet 6 inches above the ordnance storage area; lightweight concrete pit covers, CBC relocatable cell wall, and normal concrete floor and footings. Story-2 is a conventional, preengineered, lightweight metal building with no earth cover. The conceptual design of the HP Magazine is described in Figures 4-1 through 4-7. Story-1 internal space dimensions and relative floor elevations must be maintained as shown in this Section. Cross-section and material requirements, not provided in Section 4.0, are provided in Section 5.0.

4.2 STORY-1

4.2.1 Ordnance Storage Area. Ordnance storage areas are located at each end of the earth-bermed box structure as shown in Figures 4-1, 4-2 and 4-3. Each storage area (Areas 100 and 200) consists of two storage pits (Areas 101, 103, 201, and 203), each 83 feet long by 21 feet wide by 16 feet, 6 inches high. These storage pits provide spaces which protect against sympathetic detonation from an accident in an adjacent pit. The two storage pits in each storage area are separated by a transfer aisle (Areas 102 and 202), 83-foot long by 12-foot wide, as shown in Figures 4-1, 4-2, and 4-3, for unobstructed transport of ordnance between the storage pits and the SRA (Areas 201 through 207). A relocatable, modular, cell wall, shown in Figure 4-6, can be used to subdivide a storage pit into two storage cells. Each storage pit has a cover, consisting of multiple pit covers, as shown in Figures 4-1, 4-2, and 4-7. The transfer aisle wall, relocatable cell walls, and pit covers are designed to prevent a prompt sympathetic detonation in multiple storage cells or pits.

The floor and foundation of Story-1 may be designed with normal weight reinforced concrete for the conditions at the first MILCON at Naval Air Warfare Center (NAWC), China Lake. See Section 5.0 of this report for structural requirements.

4.2.2 Shipping and Receiving Area. The Shipping and Receiving Area (SRA) is located at the center of the magazine, as shown in Figure 4-1 and 4-4. The SRA (Area 300) is used to load and unload conveyance vehicles. The vehicle is parked in the vehicle pit (Area 301). The bridge crane is used to transfer ordnance to/from a flat bed truck. A side loading dock (Area 302) and rear loading dock (Area 304) allow storage and retrieval of ordnance in side-loaded and rear-loaded covered conveyance vehicles, using a forklift truck. The side and rear loading docks plus the staging dock (Area 303) allow prestaging or temporary storage of ordnance before transfer.

The SRA transfer aisles (Areas 305, 306, and 307) provide an unobstructed path for movement of ordnance and personnel between the storage pits, loading and staging docks, and parked conveyance vehicle. Two of these SRA transfer aisles (Areas 305 and 306) also serve as nonpropagation walls that prevent a sympathetic detonation between the SRA and any weapons storage cell or pit.

4.2.3 Entrance Area. The entrance area provides the path for vehicle access (Area 401) and personnel access (Area 402) to the SRA, as shown in Figures 4-1 and 4-5. The vehicle entrance will accommodate a fully loaded truck. Personnel will enter the SRA through the personnel entrance (Area 402), climb the stairs located in Area 302, and walk along the transfer aisles (Areas 102 and 202) to reach any storage cell. The vehicle access will have a sliding steel door designed for the blast load requirements in Section 5.0 and the physical security requirements in Section 8.0 of this report. Personnel access will be through a metal, hinged door that meets the physical security requirements in Section 8.0 of this report.

4.2.4 Earth Berm. The first story box structure is earth-bermed to an elevation 3 feet 6 inches above the pit storage area, as shown in Figures 4-2 through 4-4. The earth berm serves as a barricade to prevent sympathetic detonation between adjacent magazines from fragments and debris. The earth berm also serves to direct blast overpressures and debris upward, thereby reducing the ESQD from the HP Magazine.

4.3 NONPROPAGATION ELEMENTS

The following elements of the HP Magazine are designed to prevent sympathetic detonation by utilizing CEMCOM CBC, or lightweight concrete to limit the MCE in the HPM.

Elements constructed from CEMCOM CBC material include:

- Optional relocatable storage cell walls (one each maximum in Areas 101, 103, 201, and 203)

Elements constructed from cast in place lightweight concrete include:

- Storage transfer aisle wall (Areas 102 and 202)
- SRA transfer aisle wall (Area 305 and 306 only)
- Exterior storage pit walls (Areas 101, 103, 201, and 203)
- Storage pit covers (Areas 101, 103, 201, and 203)

4.3.1 Nonpropagation Storage Transfer Aisle Wall. The nonpropagation storage transfer aisle wall (Areas 102 and 202, Figures 4-1 and 4-3) shall be constructed with cast in place lightweight concrete. The thickness of each element in the cross-section must be maintained. Refer to the Certification Test 3 (CT3) construction drawings for a preliminary design of the storage transfer aisle walls (Ref. 3). The storage transfer aisle wall must meet the structural requirements outlined in Section 5.0 of this report.

4.3.2 Nonpropagation Relocatable Storage Cell Walls. A relocatable cell wall may be placed in Areas 101, 103, 201, and 203 to reduce the MCE within a storage area to 30,000 lb. When used, the cell wall will be located at the mid point or a third point of the pit (see the stowage plans in Figures 4-8 through 4-13). Cell walls are nonpropagation walls and shall be constructed using prefabricated CBC wall modules, as shown in Figure 4-6. Refer to the CT3 construction drawings and CEMCOM specifications for the design of the CBC wall modules (References 3 and 4). Only minor changes are allowed in the explosives safety certified cell wall modules. Provisions must be added to the design, however, to allow easy removal of the granular fill and to provide crane pick-up points. Empty (without the internal sand or steel grit fill) cell wall modules are designed to weigh less than the bridge crane design load capacity (15,000 pounds). The cell wall must meet the structural requirements outlined in Section 5.0 of this report.

4.3.3 Nonpropagation SRA Transfer Aisle Wall. The SRA transfer aisle walls designated Areas 305 and 306 are nonpropagation walls. These walls shall be constructed using cast in place lightweight concrete. Refer to the construction drawings for Certification Test Structure No. 3 for a preliminary design of the storage transfer aisle walls. The SRA transfer Aisle Wall must meet the structural requirements outlined in Section 5.0 of this report.

4.3.4 Nonpropagation Exterior Storage Pit Walls. The exterior walls (earth-bermed walls) of the two storage pits (Areas 101 and 103) are nonpropagation walls. These walls shall be constructed using cast in place lightweight concrete. Refer to the construction drawings for Certification Test Structure No. 3 for a preliminary design of the storage transfer aisle walls. The exterior storage pit walls must meet the structural requirements outlined in Section 5.0 of this report.

4.3.5 Nonpropagation Storage Pit Covers. The pit covers over the two storage pits (Areas 101 and 103) are designed to prevent propagation from a 4000 pound. MCE being transferred along the storage aisle wall by the bridge crane. The explosives safety certified pit covers shall be prefabricated, lightweight concrete panels, as shown in Figure 4-7 and CT3 design drawings. The pit cover operating system (PCOS) being developed with Reference 2 and described in Section 6 of this report, will require local changes to the CT3 design. Changes may not decrease the nonpropagation properties of the pit cover (as verified by NFESC). The pit covers shall be replaceable by the HP Magazine internal bridge crane (capacity = 15,000 pounds) and openable to access any of the stowage plans shown in Figures 4-8 through 4-13. When a pit or cell storage area is open, all other pit or cell storage areas must be closed.

The pit cover must meet the operational requirements outlined in Sections 4.0 and 6.0, the structural requirements outlined in Section 5.0 and the physical security requirements outlined in Section 8.0 of this report.

4.4 STORY-2

Story-2 will be a pre-fabricated, pre-engineered, lightweight metal structure with a minimum 50-year life. The second story protects personnel and ordnance handling equipment inside the magazine from local weather conditions.

4.5 NON STRUCTURAL MATERIALS

4.5.1 Waterproofing. The facility shall be waterproofed, as required, to prevent the migration of water or moisture to interior spaces of the facility. Waterproofing details, especially the earth-bermed walls and floor of story-1, shall be designed for a 50-year life.

4.5.2 Soil Berm. The soil in the berm surrounding story-1 shall be select fill material meeting minimum requirements of NAVSEA OP-5.

4.5.3 Interior Coatings. Interior surfaces of the facility shall not be painted. Interior surfaces of joints may be coated to waterproof the joint but the coating shall be nonflammable when exposed to the hot gases associated with a fire or explosion involving explosives stored in the facility.

4.5.4 Conductive Floors. There is no requirement for conductive floors in the facility.

4.6 MATERIAL HANDLING SYSTEM

The material handling system (MHS) consists of an overhead bridge crane, a universal straddle carrier (USC), a forklift truck, and a pit cover operating system (PCOS). See Section 6.0 of this report for performance requirements of the MHS. All MHS components will be designed and supplied by contractors or agencies other than the one responsible for the drawings covered by this BOD. The operational, architectural, structural, electrical, physical security, and civil design of the HP Magazine, covered by this BOD, must accommodate the final design of the MHS. The design agency must coordinate the MHS interface with the HP Magazine and must insure that the HP Magazine design is consistent with final MHS design.

4.7 ORDNANCE STOWAGE PLANS

Typical stowage plans for various containerized and palletized ordnance stored in the storage pits (Areas 101, 103, 201, and 203) of the HP Magazine are presented in Figures 4-8 through 4-13. The stowage plans comply with the following stowage requirements.

- 0.6-inch minimum air space between any ordnance and an exterior pit wall.

- 1-foot-6-inch minimum distance between adjacent stacks of containers, canisters, pallets and walls in order to couple the universal straddle carrier to the ordnance stack. Specific ordnance, such as the MK 48 torpedo, Walleye II, MK82 bombs, Shrike, 5"/54 projectile, TOW, Hawk, and 20mm an 50 cal cartridges, require a 2-foot-2-inch minimum separation from adjacent stacks of ordnance. For ordnance not listed in this document, it is the responsibility of the magazine user and the Naval Packaging, Handling, Storage, and Transportability (PHST) Center, Naval Weapons Station Earle to determine minimum separation distances.

- 3-foot minimum distance from the faces of transfer aisle walls and relocatable cell walls to the face of bombs and other ordnance having a high explosive density per cubic foot of ordnance.

- 2-foot-6-inch minimum aisle space along width of storage cell (21-foot), somewhere along the length of each storage cell in order to deploy the stow-away cell ladder.

- 1-foot-4-inch minimum aisle space along length of each storage cell (parallel to transfer aisle) for personnel to inspect ends of any container or canister.

- All ordnance items in the same storage cell shall be from the same HPM Storage Compatibility Group.

- The stack height shall not exceed 15 feet, 6 inches or the safe maximum number of containers, canisters, or pallets allowed in a stack, whichever is less.

- All ordnance in the same storage cell must be compatible for storage, as defined by NAVSEA OP-5 explosives safety regulations.

- Ordnance items having a thick skin and high explosive density, such as the MK80 Series bombs, shall be stored with their long axis parallel to the storage transfer aisle.

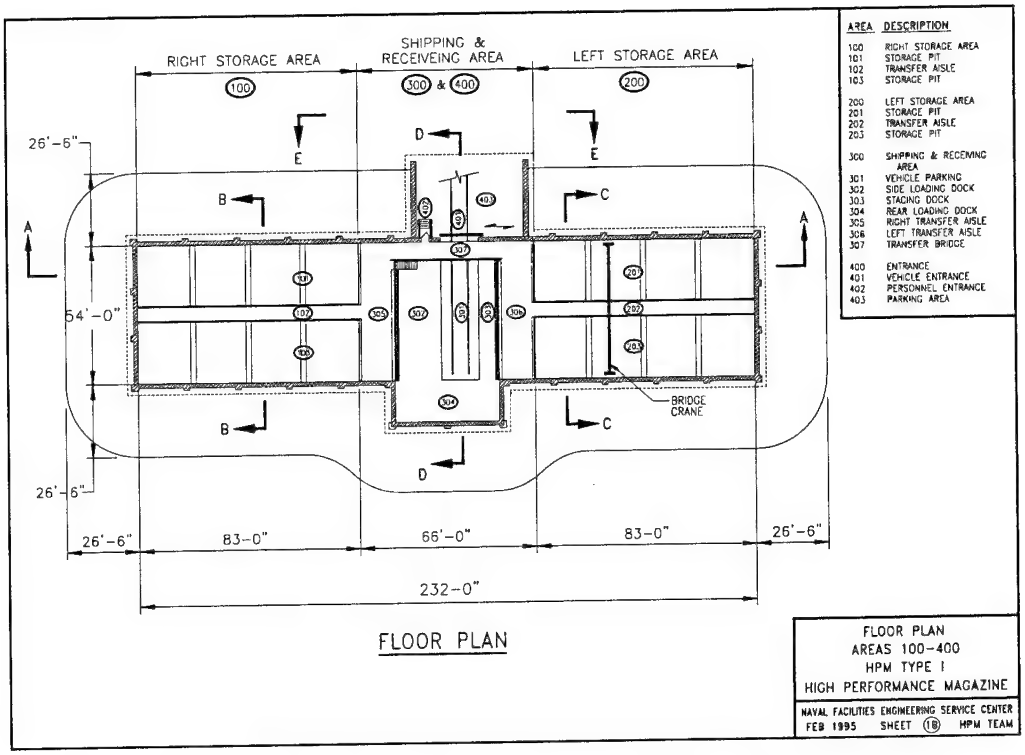


Figure 4-1. High Performance Magazine, Type 1: Section A-A elevation view of storage areas and shipping and receiving area.

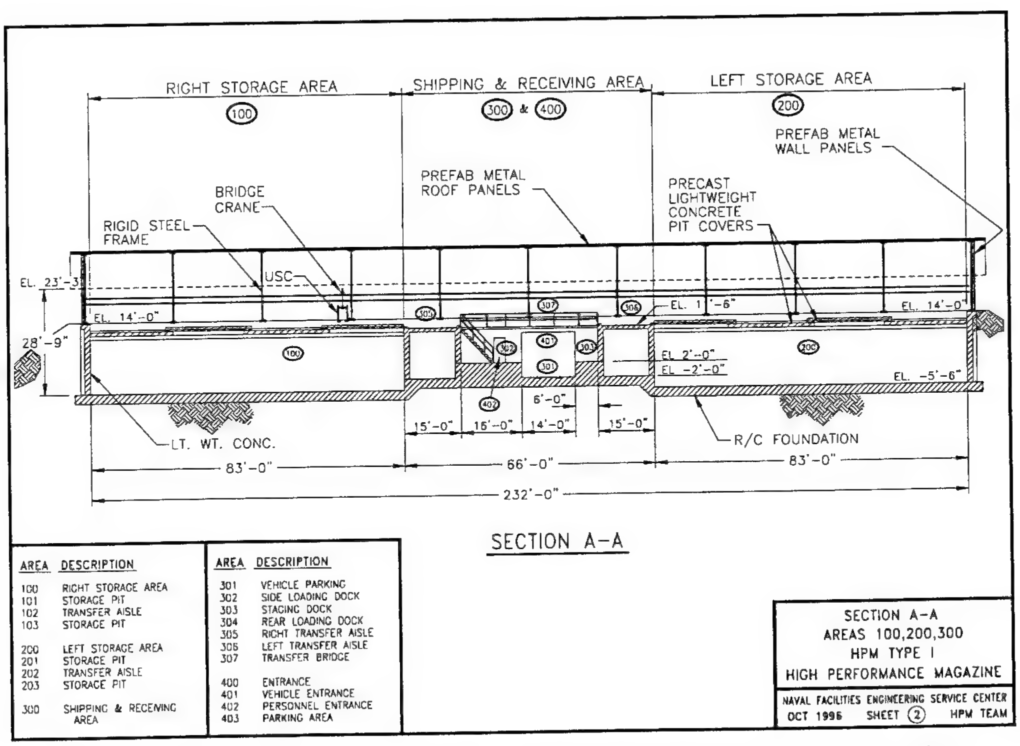


Figure 4-2. High Performance Magazine, Type 1: Section A-A elevation view of storage areas and shipping and receiving area.

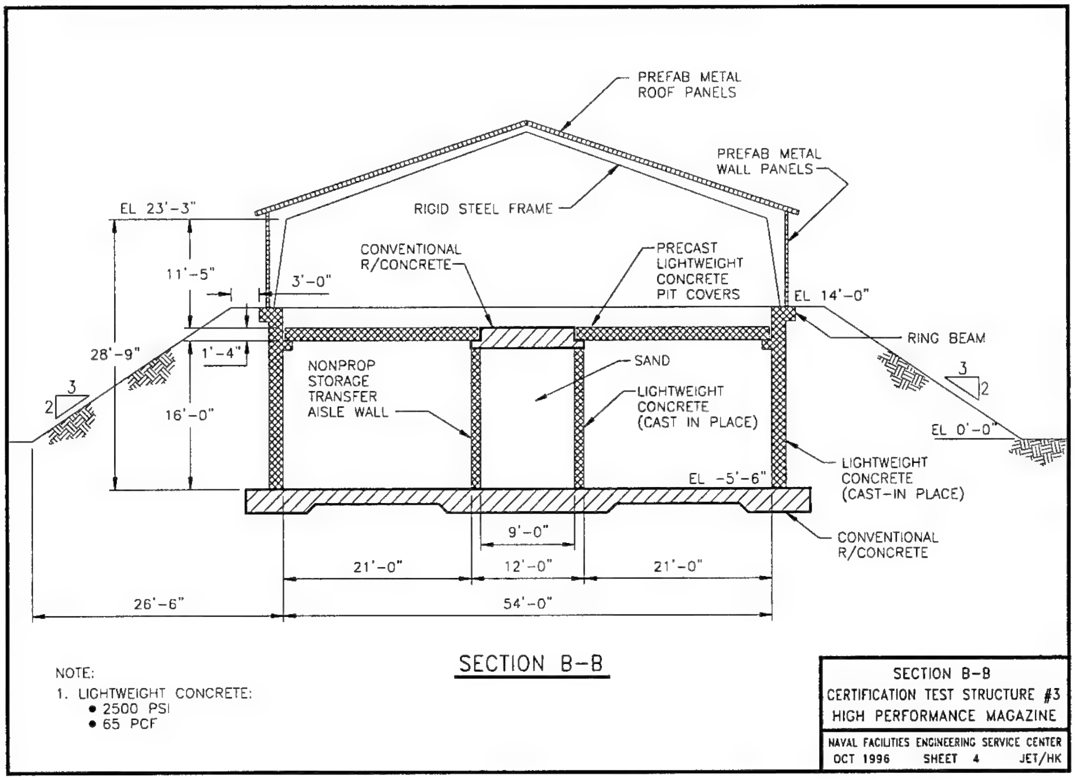


Figure 4-3. High Performance Magazine, Type 1: Section B-B elevation view of right storage area.

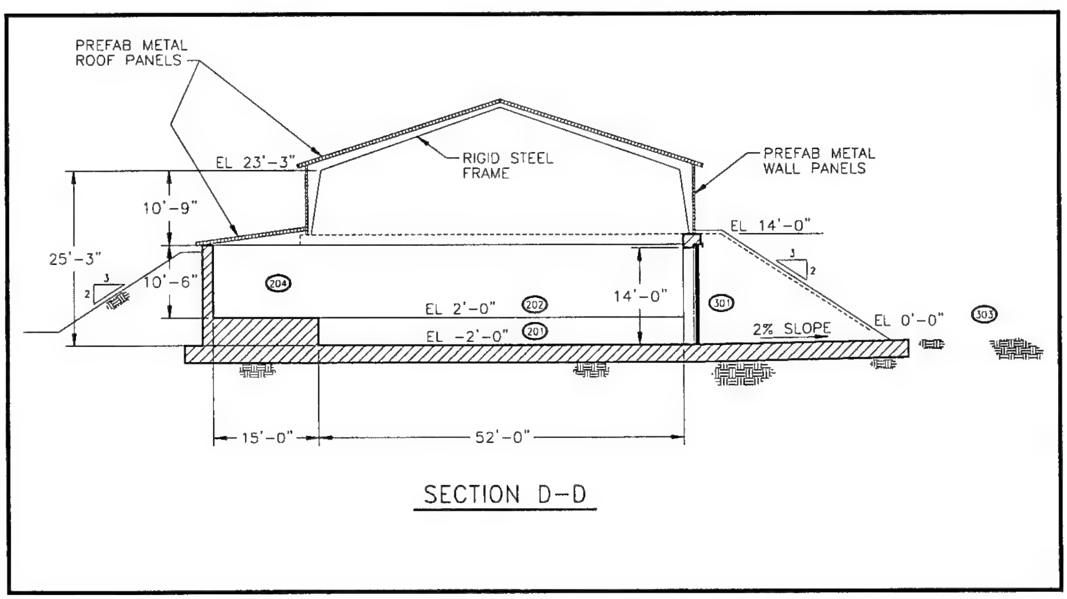


Figure 4-4. High Performance Magazine, Type 1: Section D-D elevation view of shipping and receiving area.

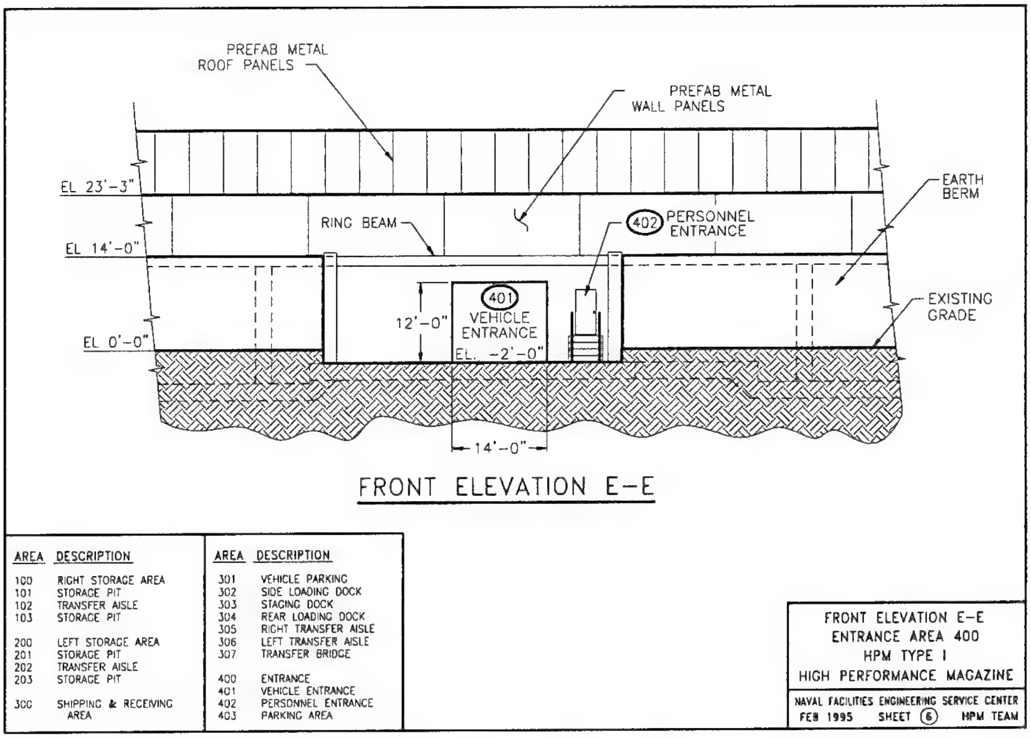


Figure 4-5. High Performance Magazine, Type 1: Section E-E elevation view of magazine entrance area.

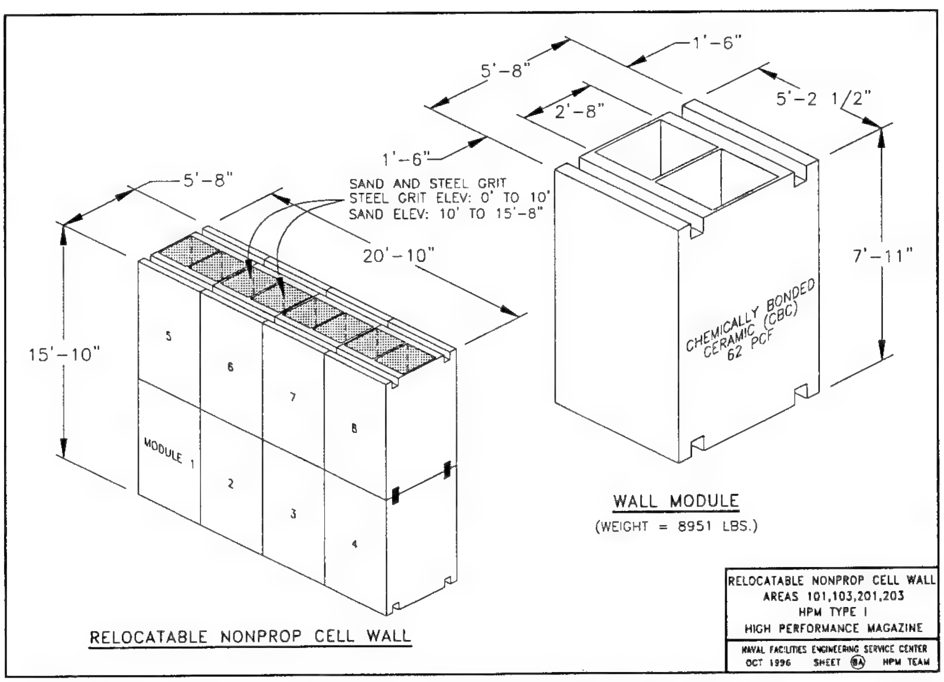


Figure 4-6. High Performance Magazine, Type 1: High Performance Magazine, Type 1: Nonpropagation relocatable storage cell wall.

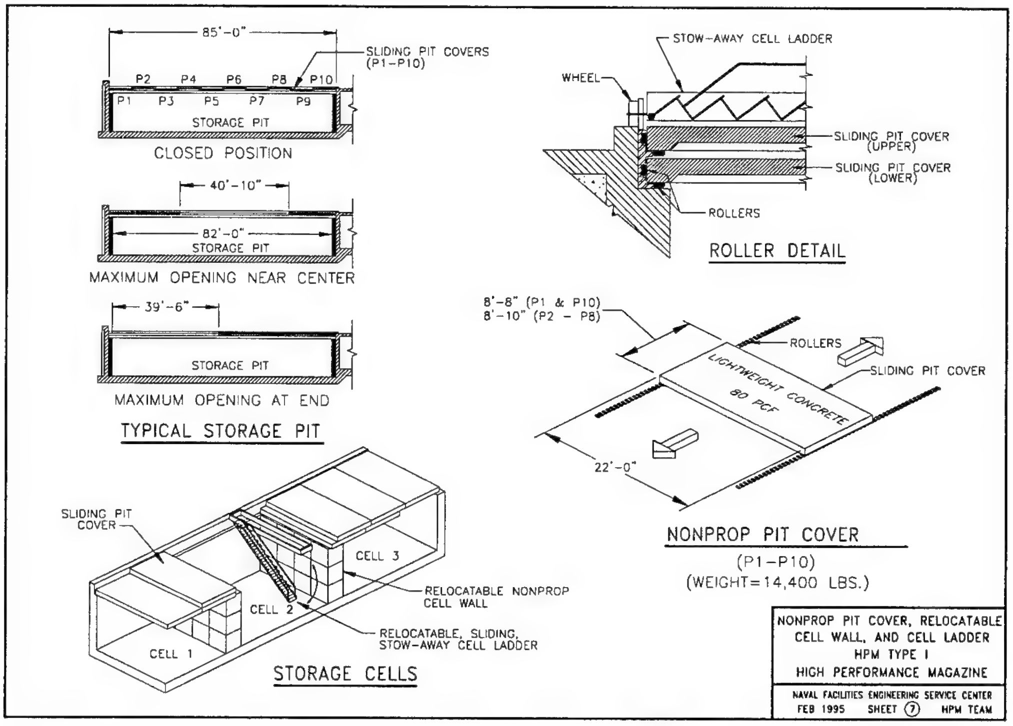


Figure 4-7. High Performance Magazine, Type 1: High Performance Magazine, Type 1: Sliding pit cover, nonpropagation storage cell wall, and sliding cell ladder.

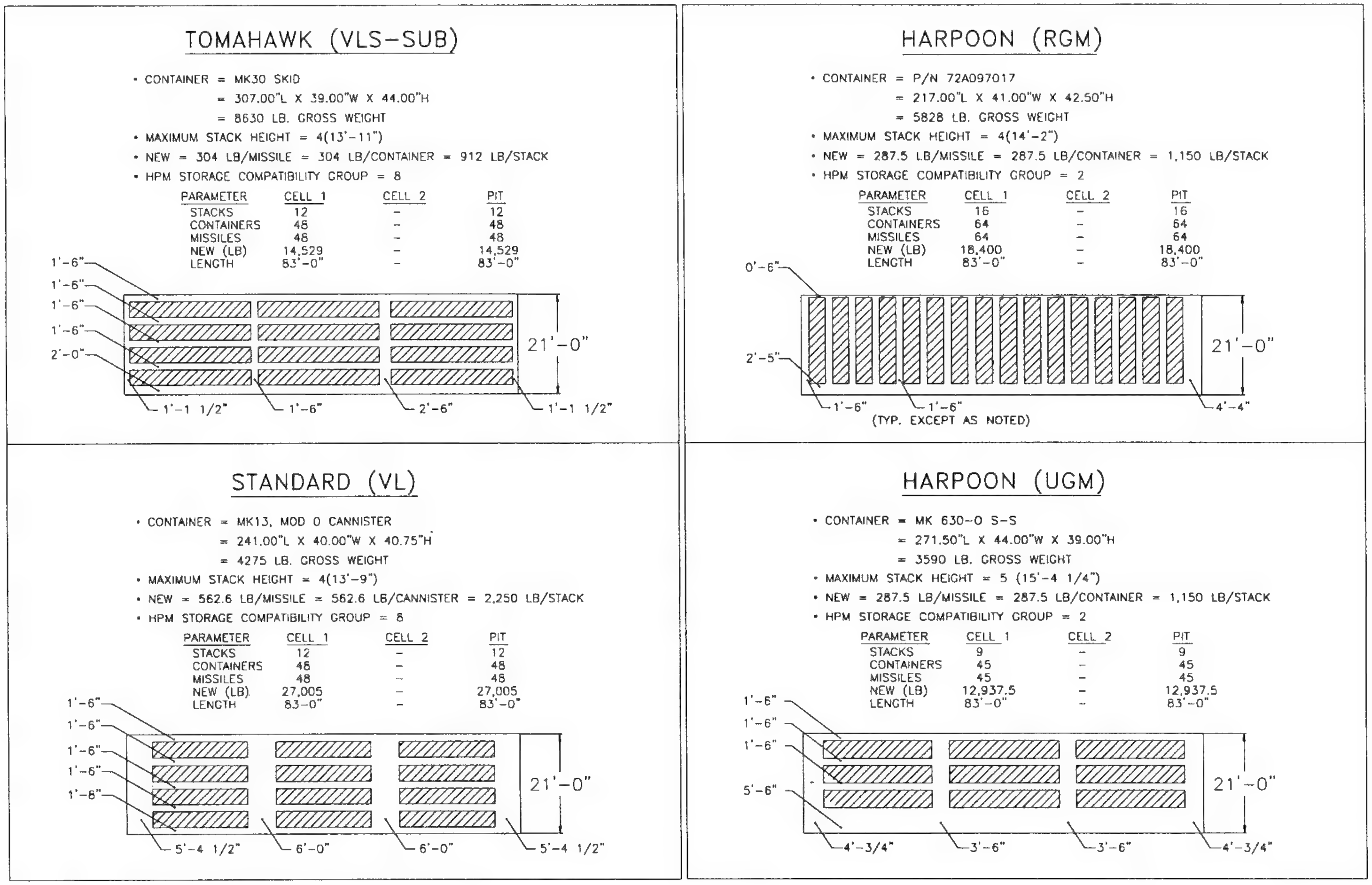


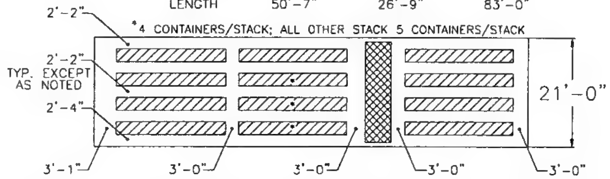
Figure 4-8. HPM stowage plans: Tomahawk (VLS-SUB), Standard (VL), Harpoon (RGM), and Harpoon (UGM).

TORPEDO (MK48)

- CONTAINER = MK 481-1
  = 249.00"L X 30.00"W X 34.00"H
  = 5700 LB. GROSS WEIGHT
- MAXIMUM STACK HEIGHT = 5(14'-2")
- NEW = 800 LB/TORPEDO = 800 LB/CONTAINER = 3,200 LB/STACK
- HPM STORAGE COMPATIBILITY GROUP = 2

PARAMETER	CELL 1	CELL 2	PIT
STACKS	7.40	5	14.25
CONTAINERS	37	20	57
TORPEDOES	37	20	57
NEW (LB)	29,600	16,000	45,600
LENGTH	50'-7"	26'-9"	83'-0"

*4 CONTAINERS/STACK; ALL OTHER STACK 5 CONTAINERS/STACK

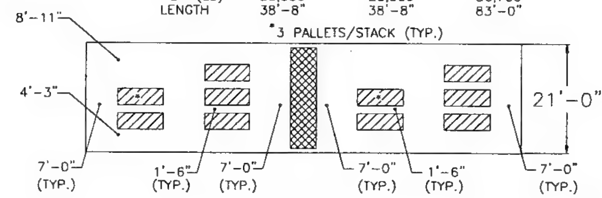


BOMB (MK84)

- PALLET = 104.00"L X 38.00"W X 24.25"H
  = 4075 LB. GROSS WEIGHT
- MAXIMUM STACK HEIGHT = 5(10"-1 1/4")
- NEW = 945 LB/BOMB = 1,890 LB/PALLET = 9,450 LB/STACK
- HPM STORAGE COMPATIBILITY GROUP = 4

PARAMETER	CELL 1	CELL 2	PIT
STACKS	5*	5*	10*
PALLETS	15	15	30
BOMBS	30	30	60
NEW (LB)	28,350	28,350	56,700
LENGTH	38'-8"	38'-8"	83'-0"

*3 PALLETS/STACK (TYP.)

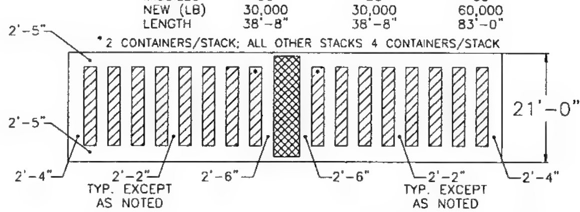


WALLEYE II (MK37-3)

- CONTAINER = CNU 154A/E S-S
  = 182.00"L X 28.00"W X 32.00"H
  = 2950 LB. GROSS WEIGHT
- MAXIMUM STACK HEIGHT = 5(13'-4")
- NEW = 1,000 LB/MISSILE = 1,000 LB/CONTAINER = 4,000 LB/STACK
- HPM STORAGE COMPATIBILITY GROUP = 8

PARAMETER	CELL 1	CELL 2	PIT
STACKS	7.5*	7.5	15*
CONTAINERS	30	30	60
MISSILES	30	30	60
NEW (LB)	30,000	30,000	60,000
LENGTH	38'-8"	38'-8"	83'-0"

*2 CONTAINERS/STACK; ALL OTHER STACKS 4 CONTAINERS/STACK



BOMB (MK82)

- PALLET = 48.00"L X 30.00"W X 30.00"H
  = 3147 LB. GROSS WEIGHT
- MAXIMUM STACK HEIGHT = 4(10'-0")
- NEW = 192 LB/BOMB = 1,152 LB/PALLET = 4,608 LB/STACK
- HPM STORAGE COMPATIBILITY GROUP = 4

PARAMETER	CELL 1	CELL 2	PIT
STACKS	12*	12*	24*
PALLETS	24	24	48
BOMBS	144	144	288
NEW (LB)	27,648	27,648	55,296
LENGTH	38'-8"	38'-8"	83'-0"

*2 PALLETS/STACK (TYP.)

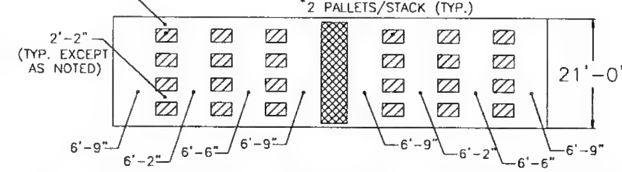


Figure 4-9. HPM stowage plans: Mk 48 Torpedo, Walleye II (Mk37-3), Mk84 Bombs, and Mk 82 Bombs.

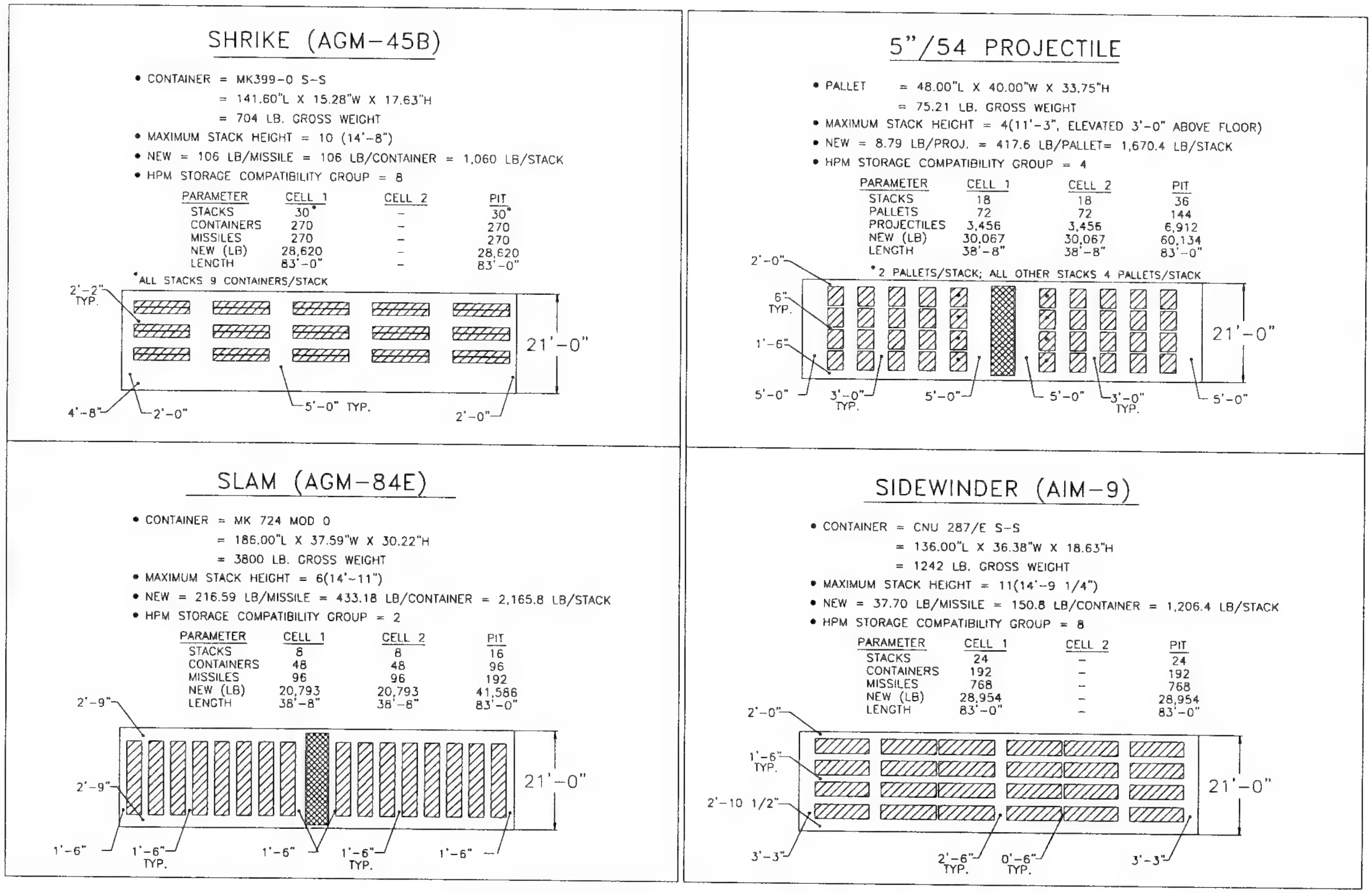


Figure 4-10. HPM stowage plans: Shrike (AGM-45B), SLAM (AGM-84E), 5"/54 Projectile, and Sidewinder (AIM-9).

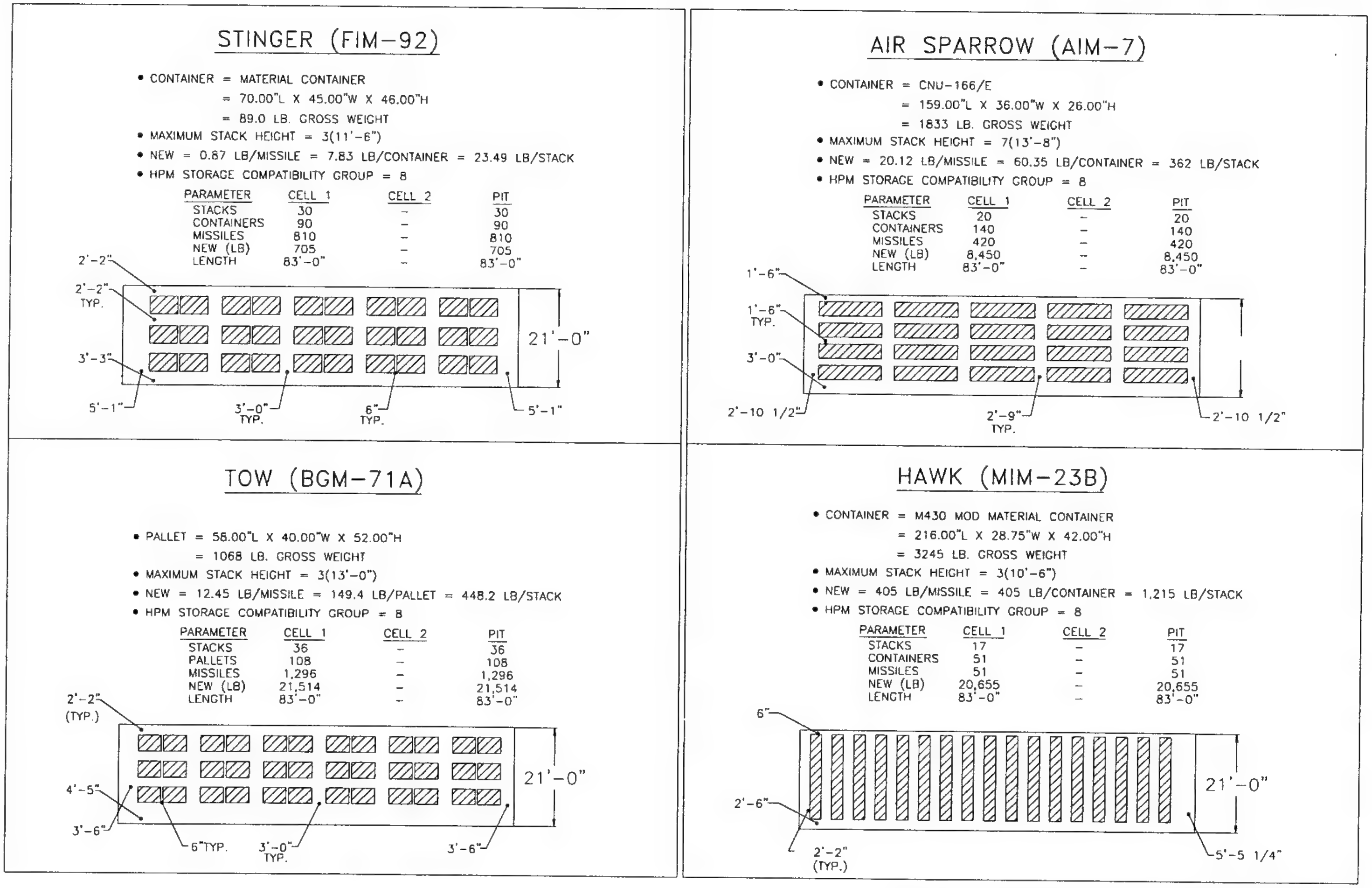


Figure 4-11. HPM stowage plans: Stinger (FIM-92), TOW (BGM-71A), Air sparrow (AIM-7), and Hawk (MIM-23B).

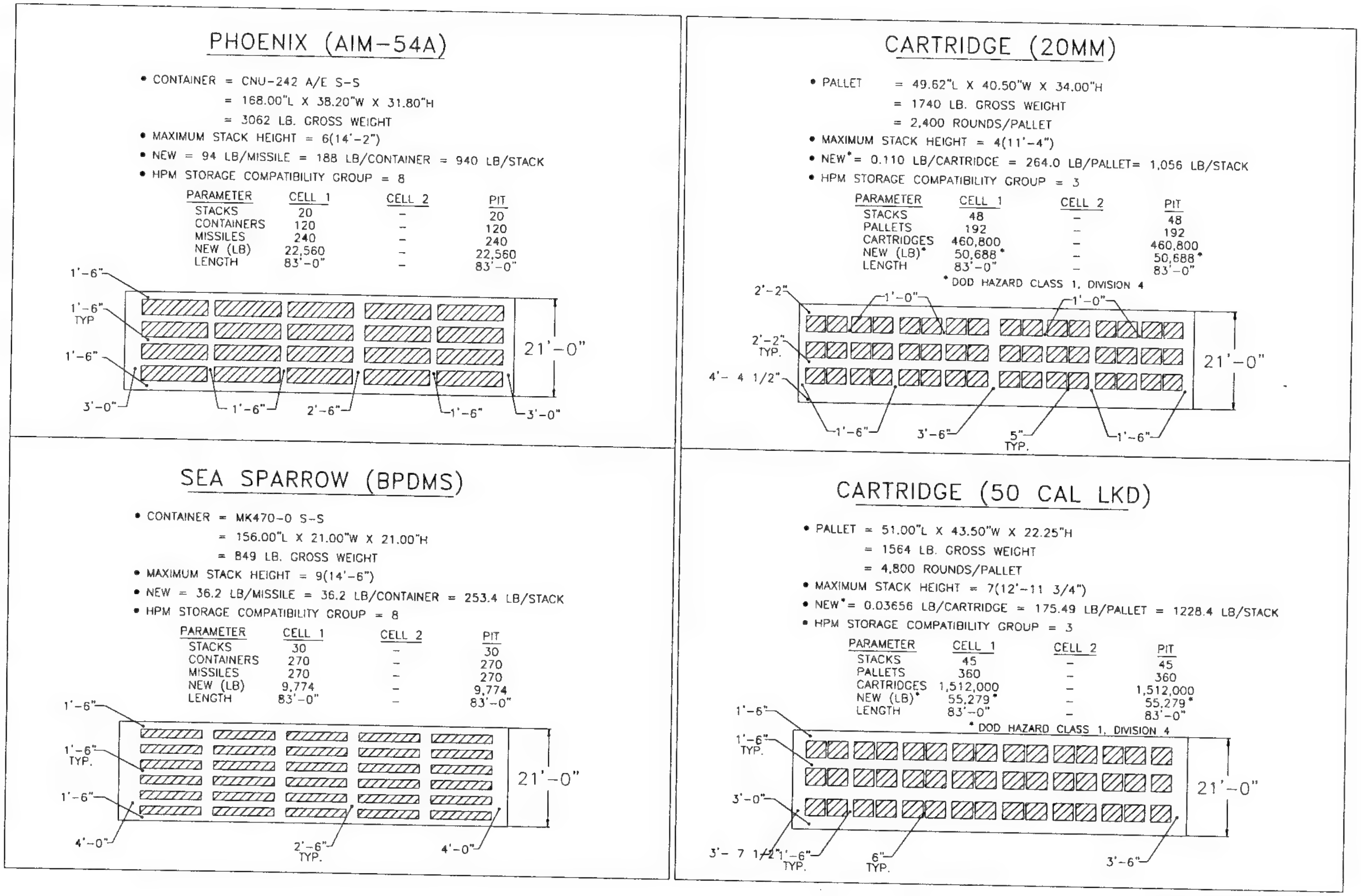


Figure 4-12. HPM stowage plans: Phoenix (AIM-54A), and Sea Sparrow (BPDMS),Cartridge (20mm), and Cartridge (50 CAL LKD).

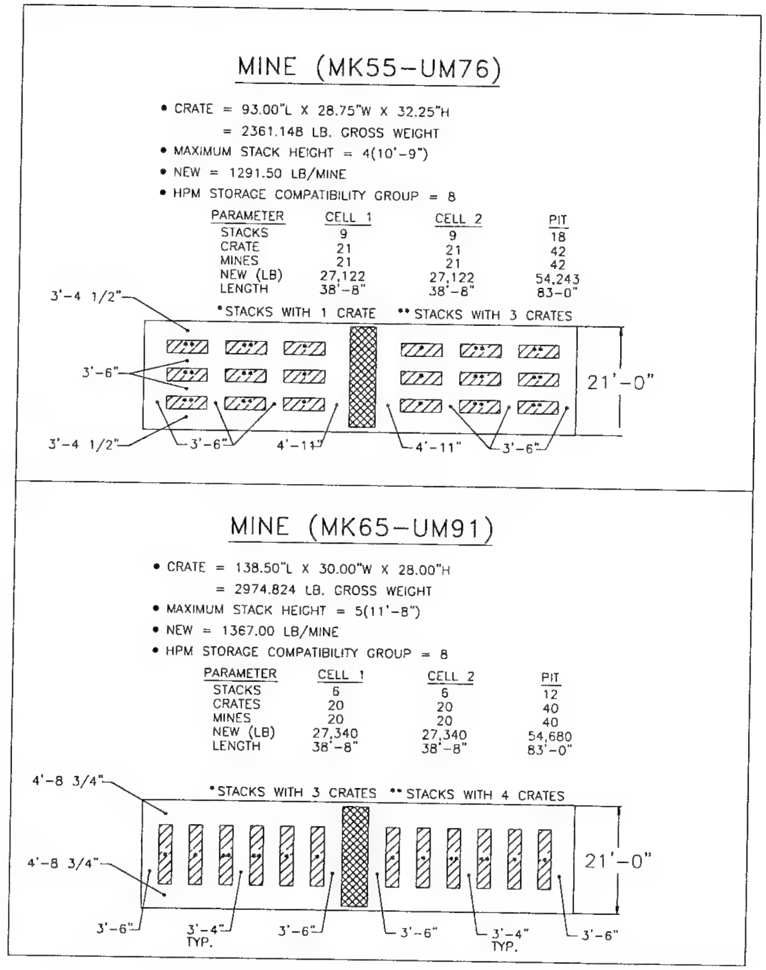


Figure 4-13. HPM stowage plans: Mine (Mk55-UM76), and Mine (Mk65-UM91).

5.0 STRUCTURAL

5.1 GENERAL

The nonpropagation walls and pit covers separating weapons storage and the shipping and receiving areas (Areas 100 and 200, see Figures 4-1 through 4-3) have been developed by NFESC to prevent propagation of accidental explosions between different areas inside the magazine. The exterior walls surrounding Areas 100 and 200 are designed to prevent propagation of accidental explosions from adjacent magazines. The wall and magazine door separating the shipping and receiving, and entrance areas (Areas 300 and 400, see Figure 4-1) require a blast resistant design to prevent propagation of an accidental explosion from an adjacent magazine. The pit covers shall also be designed to prevent propagation from an accident in an adjacent magazine.

The design drawings, calculations, and specifications for the CT3 structure (Ref.3) shall be used as a guideline for the standard design. Changes from the CT3 design shall be reviewed by NFESC for explosives safety.

5.2 STORY-1

5.2.1 Lightweight Concrete Nonpropagation Walls. The exterior magazine walls of the storage pits, the SRA transfer aisle walls, and the storage transfer aisle wall, are designed to prevent propagation between ordnance. They all require a lightweight, structural concrete (85 pcf maximum) with a compression strength, f_c', of 2,500 to 3,000 psi. The lightweight concrete walls must be designed for normal structural loads (e.g., to resist lateral earth loads from the earth berm). There is no blast resistant design requirement. Deviations in the cross-section (including rebar size and spacing) from the Reference 3 design, are possible but will require analysis by NFESC for explosives safety. Special requirements for each wall include:

- The nonpropagation exterior walls require a minimum of 12 inches of lightweight concrete cover on the interior side of the wall to absorb energy and mitigate the impact loads on acceptor ordnance.

- The nonpropagation transfer aisle walls absorb strain energy, reduce kinetic energy, and provide thermal insulation to mitigate acceptor loads from the design hazard scenarios. A sand fill is used to reduce the kinetic energy of the transfer walls on impact with acceptors. A minimum of 12 inches of cover is required on the outside surface to mitigate the impact loads on acceptor ordnance. The cross-section (15 feet total thickness) of the SRA transfer aisle wall is 12 feet of sand, sandwiched between two, 1-

foot-5-inch thick, lightweight concrete walls. The cross-section (12 feet total thickness) of the storage transfer aisle wall is 9 feet of sand, sandwiched between two, 1-foot-6-inch thick, lightweight concrete walls.

5.2.2 Nonpropagation Relocatable Cell Wall. The nonpropagation relocatable cell wall consists of reinforced hollow CBC blocks with granular fill. CBC is a lightweight (60 pcf) "Chemically Bonded Ceramic" with a compression strength, f_c', of 2,500 psi and a strain capacity (at nearly constant crushing strength of f_c') of about 60 percent. CBC is a lightweight, porous, cementitious material developed for NFESC by CEMCOM Research Associates, Inc., under U.S. Navy contract number N47408-93-C-7357. The design and performance of CBC are described in References 4 and 5.

The CBC mix to be used in the HP Magazine is designated MBW-60 (Ref. 4). The MBW-60 mix uses Type III Portland cement which provides the properties needed for nonpropagation elements in the HP Magazine. The development and characteristics of the MBW-60 mix are described in Reference 4. The state-of-the-art for CBC requires that it be precast in a controlled environment.

The CBC absorbs strain energy, reduces kinetic energy, and provides thermal insulation to mitigate acceptor loads from the design hazard scenarios. The wire mesh reinforced CBC blocks have 18-inch thick walls connected by 1-foot, 5-inch thick structural webs in the depth of the wall. A granular fill is used to reduce the kinetic energy of the wall on impact with the acceptor. The cross-section (5 feet, 8 inches total thickness) of the cell wall is 3 feet of CBC and 2 feet, 8 inches of granular fill. The cell walls are filled with steel grit to a height of 10 feet and with sand above 10 feet.

The cross-section material thicknesses were designed to prevent sympathetic detonation. The reinforcing steel size and placement is designed for normal structural loads. Deviations in the CT3 design must be analyzed by NFESC for explosives safety. The weight of the empty CBC block must not exceed the HP Magazine bridge crane capacity (15,000 pounds). Deviations could include provisions for crane lift points and openings to remove granular fill.

5.2.3 SRA Exterior Walls. The exterior walls of the SRA shall be designed as cast-in-place reinforced concrete. The unbermed door and headwall at the vehicle entrance shall be designed to prevent explosive propagation to ordnance in the SRA from a detonation in an adjacent magazine (i.e., 350,000 pounds at intermagazine distance). NFESC will provide the design blast loads for the door and headwall.

5.3 STORY-2

Story-2 will be a pre-fabricated, pre-engineered, lightweight metal structure with a minimum 50-year life. The second story protects personnel and ordnance handling equipment inside the magazine from local weather conditions. The framing shall support normal dead and live loads, including the 7.5-ton bridge crane loads described in Section 6.0 of this report.

5.4 DESIGN LOADS

5.4.1 Design Dead Loads. Design dead loads shall be based on the following material weights:

Material	Weight (lb/ft^3)
Lightweight Concrete	85
CBC	60
Steel Grit	270
Sand	100

5.4.2 Design Live Loads. Design live loads are as follow:

Area		Live Load (psf)
Name	Number	
Storage Pit (floors)	101,103,201,203	256[a]
Right Storage Transfer Aisle	102	297[a]
Left Storage Transfer Aisle	202	297[a]
Vehicle Parking	301	as required
Side Loading Dock	302	256[a]
Staging Dock	303	256[a]
Rear Loading Dock	304	256[a]
Right SRA Transfer Aisle	305	297[b]
Left SRA Transfer Aisle	306	297[b]
SRA Transfer Bridge	307	as required
Storage Pit Covers	101,103,201,203	100[c]

Notes:
a Worst Case = Harpoon (RGM) missiles
b Worst Case = Mk84 bombs
c Personnel

5.4.3 Design Blast Loads. The headwall and doors in Area 300 (Figure 4-1) shall be designed to safely resist the blast loading resulting from the MCE in an adjacent standard earth covered concrete box magazine, storing 350,000 pounds NEW, and sited at the intermagazine distance for a standard earth covered magazine. Standard drawings for the magazine door of the Type C box magazine, see Reference 6, may be modified for use in the HPM. Design blast loads shall be provided by NFESC.

7.0 ELECTRICAL

7.1 GENERAL

The following electrical requirements are preliminary. The electrical power and control systems will be determined from the final designs of the material handling system (MHS) and the pit cover moving system.

7.2 LIGHTING

Lighting fixtures shall be surface mounted or suspended so it does not interfere with ordnance handling equipment. There is no requirement for explosion-proof light fixtures in the magazine. Lighting circuits shall be individually controlled by area.

7.2.1 Interior Lighting. Interior lighting shall be 10 foot-candles at the working level. All electrical equipment in magazines shall conform to U.S. National Electrical Code NFPA-70 for Hazardous Locations (Class I, Division 2, Group D, and Class II, Division 2).

7.2.2 Exterior Lighting. Area lighting outside the magazine shall have an intensity of 10-foot-candles. Light fixtures shall be weatherproof. Consider the use of solar-powered exterior lighting to conserve energy and to reduce the required amount of electrical wiring.

7.2.3 Emergency Lighting. A battery-pack emergency lighting unit shall be installed in Areas 100, 200, and 300 of the magazine. Units shall be located to provide identification of exit doors and safe egress.

7.3 CONDUITS AND JUNCTION BOXES

Wherever possible, wiring conduits shall be concealed in the floor or walls with device or junction boxes provided for interconnection with the electrical devices (switches, monitors, solenoids, etc.). Conduits shall be rigid metal conduit or liquid-tight, flexible conduit as appropriate. Wire shall be THW or THWN as appropriate. The junctions boxes shall be located to provide minimum lengths of flexible conduit. There is no requirement for explosion-proof junction boxes.

7.4 ELECTRICAL POWER

Electrical power system requirements shall be developed from the final design for the material handling system and pit cover moving system.

7.5 PRIMARY GROUNDING SYSTEM

The primary grounding system is designed to provide earth termination for the lightning protection system's down conductors. The primary grounding system consists of ground rods and buried uninsulated copper cable interconnecting the rods. The cable should not be less than AWG No. 1/0 with strands not less than AWG No. 17. The depth of burial should be at least 30 inches, although local codes may dictate deeper depths, and no closer than 3 feet from the exterior of the building. If a secondary grounding system is installed, the primary ground system should be located at least 3 feet outside the secondary ground girdle. Structures protected by a single mast or facilities with areas of 500 square feet or less do not need a ground loop conductor.

The resistance to earth of the primary grounding system shall be no greater than 25 ohms and the resistance between the primary grounding system and the secondary grounding system shall be less than 1-ohm.

7.6 SECONDARY GROUNDING SYSTEM

The secondary grounding system provides a common ground with all other grounds (except the primary lightning protection ground) that may exist in or around an ordnance facility. The girdle shall consist of a continuous loop of buried AWG No. 1/0 or larger copper or copper clad steel cable buried no closer than 3 feet from the outside wall of a structure. The depth of this cable shall be as required by local ordinances, but should be at least 30 inches. The secondary grounding system is composed of a girdle with the grounding subsystems listed below. The secondary grounding system provides a minimum of protection from the effects of lightning (required for all structures) by providing a common grounding point for any item in the structure that requires grounding. All grounds must be interconnected with the secondary ground girdle. In addition to the lightning protection grounding system discussed in Section 7.6 of this report, the types of grounds discussed in the following paragraphs must be provided for an ordnance facility and must be bonded to the secondary ground girdle.

None of these above ground circuits are to be interconnected within a building. Therefore, the hooks of all cranes and hoists must be electrically isolated from all other ground systems. Each system is to have its own separate and distinct lead to a ground point outside of the building. Ground leads are to use insulated wire to maintain isolation between the ground circuits. All grounds shall use insulated wire where they pass through a facility wall.

7.6.1 Power System Ground. The NEC, National Fire Protection Association Lighting Protection Code (NFPA) 70 requires that the electrical power systems and equipment be

intentionally grounded. The intentional grounding of electrical power systems provides a path for fault currents and provides a 0-volt reference for electrical equipment and surge suppression circuitty. Refer to NFPA 70 for specific requirements for the installation of this ground. In general, there are two parts of the power system ground: the equipment ground and the wiring system ground.

7.6.1.1 Equipment Ground. Equipment grounding relates to the manner in which non-electrical conductive material, which either encloses energized conductors or is adjacent thereto, is to be interconnected and grounded. The basic objectives of this ground are:

- To provide freedom from dangerous electric-shock-voltage exposure to persons in the area.
- To provide current-carrying capability, both in magnitude and duration, adequate to accept the ground-fault current permitted by the overcurrent protection system without creating a fire or explosive hazard to building or contents.
- To contribute to superior performance of the electrical system. Basically, this means that the grounding conductor must return the ground-fault current without introducing enough additional impedance that would impair the operating performance of the overcurrent protection system.

7.6.1.2 Wiring System Ground. This consists of grounding one of the wires of the electrical system to the electrical panel buss. This buss is connected to the power system ground rod (as required by the NEC) which is then connected to the secondary girdle (usually the neutral, depending upon the type of system), and if necessary, adding a safety ground wire to the system to limit the voltage on the circuit which might otherwise occur through exposure to lightning or other voltages higher than the design of the circuit. Another purpose would be to limit the maximum voltage allowed to ground under normal operating conditions. A system which operates with one of its conductors intentionally grounded will provide automatic opening of the circuit if an accidental or fault ground current occurs on an ungrounded conductor.

7.6.2 Static Ground. Static ground systems are provided to prevent the accumulation of static electricity by providing a path for dissipation of an electrical charge buildup. The static ground system may be connected to structural steel, ground cones, buried copper plates, and rods driven into the earth. All of these items must be interconnected with the secondary ground girdle.

7.6.3 Structural Grounds. The purpose of the structural ground is to bond all the structural steel in a facility to the secondary ground girdle. This will preclude any sideflash problems as a result of lightning strikes. The structural steel in all ordnance operating buildings shall be bonded to the secondary ground girdle with a AWG 1/0 or larger copper or copper clad cable. No greater than 1-ohm resistance shall exist between the structural steel frame and the secondary ground girdle.

7.7 LIGHTNING PROTECTION

7.7.1 General. The fundamental principle in the protection of life and property against lightning is to provide a means by which a lightning discharge can enter or leave the earth without resulting damage or loss. A low impedance path must be offered which the discharge current will follow in preference to all alternative high impedance paths offered by building materials. Most metals, being good electrical conductors, are virtually unaffected by either heat or the mechanical forces if they are of sufficient size to carry the current that can be expected. The metal path must be continuous and shall form a two-way path from each air terminal horizontally or downward to connections with ground terminals. A nonferrous metal such as copper should be used as the conductors to assure the integrity of the lightning conductor for an extended period of time. The National Fire Protection Association Lightning Protection Code (NFPA 780) as supplemented by the requirements of NAVSEA OP-5 provide the minimum acceptable requirements for the protection of structures used for testing, handling or storing explosives from the effects of direct and indirect lightning strikes. MIL-HDBK-1004/6, and MIL-HDBK-419 provide additional information on the installation of lightning protection systems for Navy explosives facilities.

7.7.2 Policy for Lightning Protection. Lightning protection is required for all ordnance handling, operating, and storage facilities. To provide minimum protection for structures against direct lightning strikes, five requirements must be fulfilled:

(1) An air terminal must be provided to intentionally intercept lightning at 100-foot or less striking arc.

(2) A path must be established that connects this terminal to earth with such a low impedance that the discharge follows it in preference to any other.

(3) A low resistance connection must be made with the earth electrode subsystem.

(4) A low impedance interface must be established between the earth electrode subsystem and earth.

(5) Sideflash and surge protection must be provided.

These conditions are met when a lightning discharge is permitted to enter or leave the earth while passing through only conducting parts of a structure.

7.7.3 Lightning Protection Systems. A lightning protection system consists of an air termination network, down conductors, primary and secondary grounding systems, and bonding conductors to interconnect conductive bodies attached to or inside the structure.

An air termination system is the part of the lightning protection system designed to provide the primary attachment point for a lightning strike. The two common types of air termination systems approved for the protection of Navy explosives facilities are:

- **Mast System**. A mast-type lightning protection system uses masts (either metallic or wood) that are remote from the structure to provide the primary attachment point for a lightning discharge. If the mast is constructed of wood, an air terminal or metal cap connected to two down conductors must be installed on it. These down conductors shall be placed symmetrically (on opposite sides) about the mast. The height (and spacing, if more than one is necessary) of the masts must be adequate to ensure that the entire structure is enclosed within a zone of protection as defined in NFPA 780 for a 100-foot striking distance. Appendix A of MIL-HDBK-1004/6 gives details and examples for determining the height and spacing of the masts.

- **Catenary (Overhead Wire) System**. A catenary lightning protection system consists of grounded, elevated horizontal metallic wires stretched between masts that surround a structure. Each wire shall be a continuous run of at least AWG No. 1/0 copper or copper-coated steel cable suspended above the protected structure and connected at each end to the primary ground girdle. The overhead cable shall be supported by masts to ensure a minimum separation distance of 6 feet from the protected structure, including any projections. This separation shall be increased by 1-foot for every 10 feet after the first 50 feet of horizontal cable run parallel to the structure. The supporting mast shall be separated from the structure by at least 6 feet. The separation shall be increased by 1-foot for every 10 feet of structure height above 50 feet. Each overhead wire shall be a continuous run of noncorrosive material equivalent in cross sectional area to a main size conductor.

7.7.4 Down Conductors. Lightning protection system down conductors shall meet the minimum requirements of NFPA 780. They shall interconnect all air terminals and shall form a two-way path from each air terminal horizontally, downward, or rising at a rate not exceeding 3 inches per foot to connections with the primary ground system. The material shall be AWG No. 1/0 copper cable with no individual strand of the cable being smaller than AWG No. 17 (0.045-inch diameter). Flat wires of equivalent resistance, commonly used in other countries, may be substituted at activities outside the United States. The down conductors shall be spaced as widely as possible. When installed on a mast, they shall be installed symmetrically about the mast. If a guy is installed on a mast, this may be included as one of the down conductors, provided it is connected to the girdle and meets the minimum resistance requirements.

7.8 GROUNDING

This section provides specific grounding requirements necessary for the lightning protection of ordnance facilities. Grounding systems shall consist of a primary and secondary grounding system. The section below provides specific requirements for primary and secondary grounding systems, as well as their interconnections.

7.8.1 Primary Grounding System. The purpose of the primary grounding system is to dissipate lightning current into the earth by providing a low impedance path to earth. Lightning protection system down conductors shall be terminated onto a buried copper or copper clad steel ground girdle. This AWG No. 1/0 or larger cable creates a continuous loop which interconnects the down conductors with ground rods that are provided for the primary grounding system.

(1) The components of an air termination system shall, via down conductors, be terminated onto a bare copper or copper-clad conductor of not less than AWG No. 1/0. The size of any strand of the cable shall not be less than AWG No. 17. This cable shall form a closed loop around the area to be protected. The resistance to ground of this ground girdle shall be 25 ohms or less.

(2) It is usually necessary to drive ground rods around the perimeter of the cable, connected to the girdle by a similar size and material cable. The rods shall be copper, copper-clad steel, stainless steel, or stainless-clad steel. They should normally be driven at no less than 10-foot intervals and spaced so they are uniformly distributed around the area to be protected.

7.8.2 Secondary Grounding System. The secondary grounding system consists of a buried copper conductor of AWG No. 1/0 or larger that interconnects all of the grounds and conductive bodies attached to or inside the structure that are to be bonded to a grounding system. A minimum of protection (required for all structures) is provided from the effects of lightning by establishing a common grounding point for any item in the structure that requires grounding. The secondary grounding system to which the primary lightning protection shall be connected, is described in Section 7.7 of this report.

7.8.3 Interconnection of Grounding Systems. The primary and secondary ground girdles shall be bonded together for all ordnance facilities. A minimum of two bonds between the girdles shall be provided. Additional bonds may be required for larger perimeter structures. It is suggested that a bond be provided for every 250 feet of secondary ground girdle. The bonds between the girdles shall be made with AWG No. 1/0 or larger copper or copper-clad steel cable or equivalent. The interconnecting cable should be the same size and material as the girdles. The interconnections should be made at a test well so the bond can be disconnected for testing.

7.9 BONDING

Bonding of metallic bodies and ground systems is required to ensure that voltage potentials produced by lightning currents are similar throughout the structure and therefore no large potential differences exist which are sufficient to produce a sideflash inside the protected structure. Bonding systems shall comply with requirements of NAVSEA OP-5.

7.10 SURGE SUPPRESSION

Lightning protection systems designed to protect the structures housing explosives must protect against induced surges on power, communication, data and process control lines, as well as any other electrical conductor entering or exiting the structure, in addition to direct lightning strikes to the structure. Nearby lightning discharges will produce electromagnetic pulses that can be coupled into conductors servicing the structure. These induced surges can be adequate to cause dangerous over-voltages, resulting in fires or damage to critical electrical hardware. Consequently, surge suppression shall be provided as part of all power, communication, data, and process control conductors that enter or exit a facility. The surge suppression can be in the form of spark gaps, metal oxide varistors, transzorbs, fiber optic data lines, isolation transformers or similar. Power and communication lines (including intrusion detection lines) shall enter the facility in shielded cables or metallic conduit run underground for at least 50 feet from the structure.

7.11 TV MONITOR

As part of the material handling system, TV cameras and LCD monitors will be used to move ordnance. Electrical requirements to be determined.

6.0 MECHANICAL

6.1 HEATING, VENTILATING, AND AIR CONDITIONING SYSTEM

Ventilation and Story-2 insulation will be provided to obtain an acceptable work environment during transfer of ordnance.

6.2 MATERIAL HANDLING SYSTEM

The material handling system (MHS) consists of an overhead bridge crane, a universal straddle carrier (USC), and a forklift truck. In the event of a crane failure, the backup may be spare parts to repair the bridge crane or a second bridge crane. The choice by the customer will depend on the use of the magazine. The second bridge crane would be utilized during normal operations but would also serve as a backup. The backup for a power failure will be a portable generator. The backups for the USC and forklift truck will be spare parts (which could include a complete second unit of each).

6.2.1 Bridge Crane. The bridge crane spans the full width (54 feet) of the HP Magazine and travels the full length (232 feet) of the magazine, as shown is Figures 4-1 through 4-4. The bridge crane is used to store and retrieve ordnance in the storage cells, to transport ordnance between the SRA and any storage cell along the storage and SRA transfer aisles, and to store and retrieve ordnance on the side-loading dock, staging dock, and conveyance vehicle in the SRA. The crane hoist has a capacity of 7.5 tons to lift the heaviest individual ordnance package in the United States Navy (USN) inventory (Tomahawk UGM-109-C (Tactical) missile weighing 8,963 pounds) or a stack of containers, canisters, or pallets loaded with ordnance, provided the loaded stack is 12,000 pounds maximum stack weight, 7 feet maximum stack height, and 4,000 pounds maximum stack explosive weight. Reference 7 provides important backup information on the development of these limits for the crane. The trolley has a twin hook hoist equipped to rotate a suspended stack of pallets or containers 90 degrees in a horizontal plane. This rotation capacity allows the length of any stack to be oriented parallel to the storage transfer aisle when transporting the stack between a storage cell and the SRA.

The bridge crane has three possible motions:

- Forward and backward travel of the crane bridge along the bridge rails.

- Right and left travel of the hoist trolley along the bridge crane.

- Up and down travel of the twin hoist hooks underneath the hoist trolley.

These motions are controlled from the floor of the transfer aisles by the operator pressing buttons on a hand-held pendent suspended from the overhead hoist. A typical speed for horizontal movement of the bridge crane or hoist trolley is 90 feet per minute. A typical lift speed for the twin hoist hooks is 10 feet per minute.

The elevation of the bridge crane above the transfer aisle floor provides the hook height needed to elevate the tallest stack of ordnance (7 feet maximum) 1-foot-6-inch above the transfer aisle surface.

6.2.2 Universal Straddle Carrier. The Universal Straddle Carrier (USC) is a device that couples the twin hoist hooks on the hoist trolley to the unit ordnance load. The unit ordnance load is either a single container, cannister, or pallet of ordnance, or a stack of containers, canisters, or pallets of ordnance. The USC is a new device being developed for the HP Magazine by the Naval Packaging, Handling, Storage, and Transportability (PHST) Center, Naval Weapons Station Earle, Colts Neck, New Jersey.

The USC is being developed to meet the following performance requirements:

- Couple to any container, cannister, or pallet.

- Couple to either one container, cannister, or pallet of ordnance, or a stack of containers, canisters or pallets of ordnance.

- Safely lift any unit ordnance load, provided the stack weight is 12,000 pounds maximum, the stack explosive weight is 4,000 pounds NEW maximum, and the stack height is 7 feet maximum.

- Couple to twin hoist hooks which can rotate the unit ordnance load 90 degrees while suspended from the hoist trolley.

- Couple to any unit ordnance load, provided the distance between adjacent stacks is 1-foot, 6-inch minimum in order to insert the USC tines in the pockets of the container, cannister, or pallet.

6.2.3 Forklift Truck. An explosion-proof forklift truck is dedicated to the loading dock areas to lift, transport, and position ordnance in side- and rear-loaded (covered) conveyance vehicles. The forklift truck has a lift capacity of at least 12,000 pounds. In such cases, the unit ordnance load is a single container, canister, or pallet of ordnance. The ordnance (stack) is transported between the storage cells and side-loading dock and staging dock using the USC and traveling bridge crane.

6.2 PIT COVER OPERATING SYSTEM

The current pit cover concept is shown in Figure 4-6. Other concepts, that meet the basic requirements in this BOD are permitted.

In the concept shown, all pit covers span the width of the storage pits from an exterior magazine wall to the transfer aisle wall. For each storage pit, the pit covers are segregated into four pit cover groups. The pit cover groups are supported by one of two sets of tracks along the length of the walls. When all the pit cover groups are in the closed position, the pit cover groups are located in an alternating pattern on an upper or lower track. This pattern allows upper and lower pit cover groups to move horizontally and permit access to an open storage cell. Rollers attached to the pit covers will allow movement along the tracks.

For a 4,000-pound MCE being transferred along the transfer aisle wall, pit covers are designed to prevent accidental detonation of ordnance in closed storage cells. The following three requirements are required to mitigate primary fragment hazards:

- 0.5-inch maximum clearance is required between the upper and lower pit covers.
- 2-foot overlap of upper and lower pit cover groups while in the closed position, see Figure 6-1a.
- 1-inch maximum clearance between the lower pit covers and the relocatable cell wall.

All pit covers spanning the width of the storage pits must be easily moveable to allow placing and retrieving of ordnance. Nominal dimensions of a pit cover is 23 feet long by 7 feet 6 inches wide by 1-foot thick. The weight of each pit cover must not exceed a maximum of 14,000 pounds if it is necessary for them to be moved by the internal bridge crane. Since they may be installed with an external construction crane, it may not be necessary to limit their weight to the capacity of the internal bridge crane. Factors to be considered include maintenance and physical security. If a pit cover must be replaced, it would be convenient to be able to use the internal bridge crane during replacement. Physical security is enhanced if the bridge crane could not pick up the pit cover.

A system must be designed to permit ease of moving the pit covers during a large number of operating cycles, provide vertical and horizontal restraint of the covers, and permit manual movement of the covers when required. The primary method of moving the pit covers may be mechanically or electrically powered. A typical speed for horizontal movement of the pit covers is 30 feet per minute.

As part of the system design, the pit cover locations must allow storage and retrieval of all ordnance items that can be stored in the HPM. Explosive safety also requires that only one storage cell in the HPM may be open during storage and retrieval of ordnance. All other storage cells must be closed. Figures 6-1a through 6-1g show proposed closed and open positions of the pit covers for providing access to a representative storage cell while satisfying explosive safety requirements. The six open positions provide access to all ordnance stowed according to Figures 4-8 through 4-13.

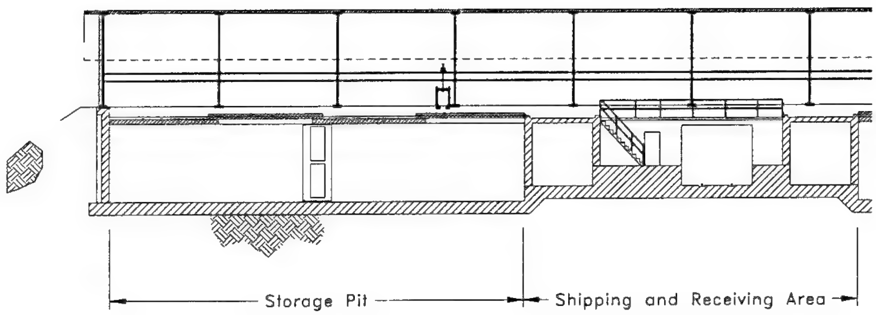


Figure 6-1a. Pit Cover Operating Locations, Closed Position.

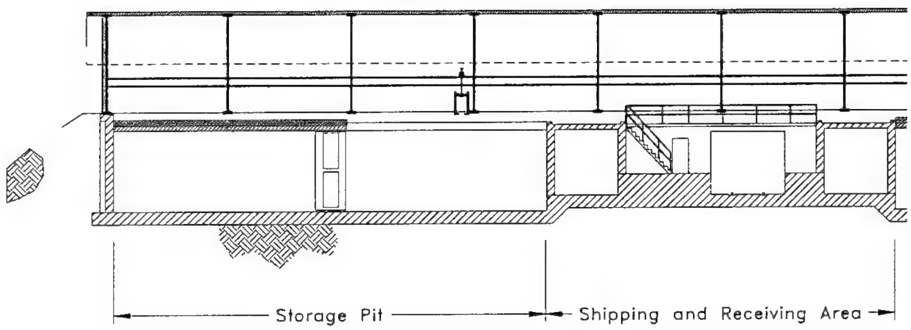


Figure 6-1b. Pit Cover Operating Locations, Open Position No. 1.

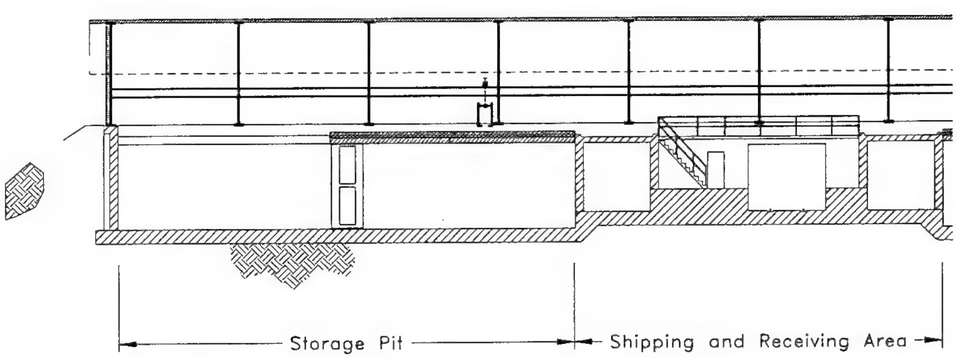


Figure 6-1c. Pit Cover Operating Locations, Open Position No. 2.

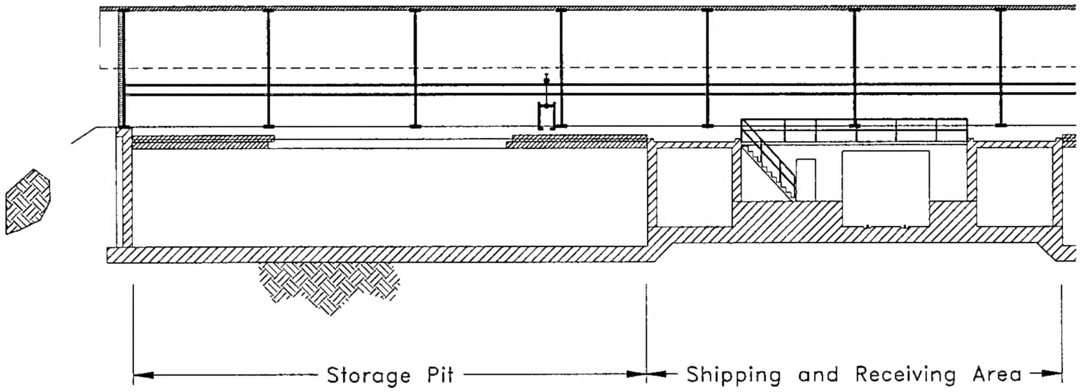


Figure 6-1d. Pit Cover Operating Locations, Open Position No. 3.

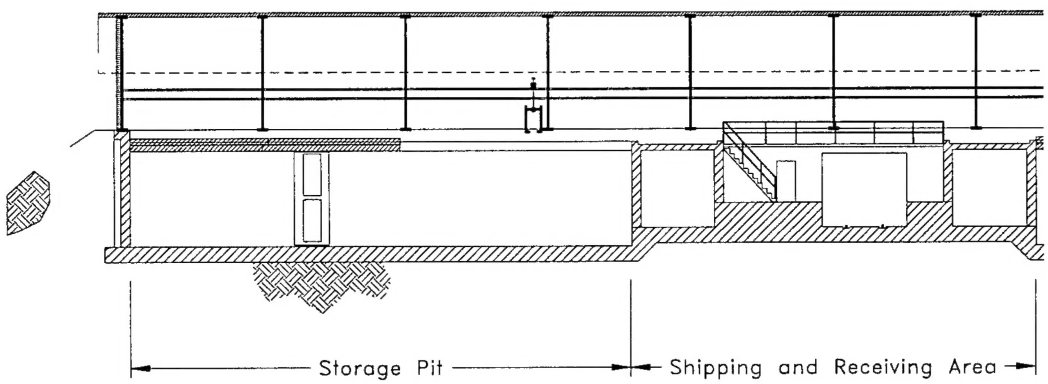


Figure 6-1e. Pit Cover Operating Locations, Open Position No. 4.

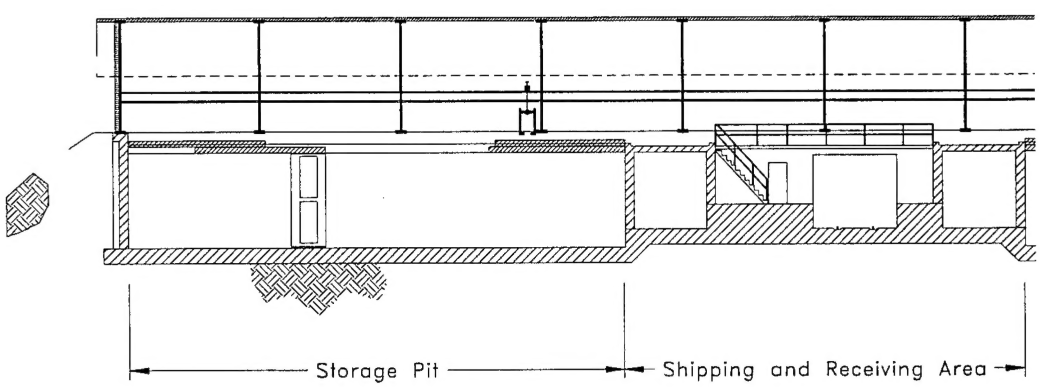


Figure 6-1f. Pit Cover Operating Locations, Open Position No. 5.

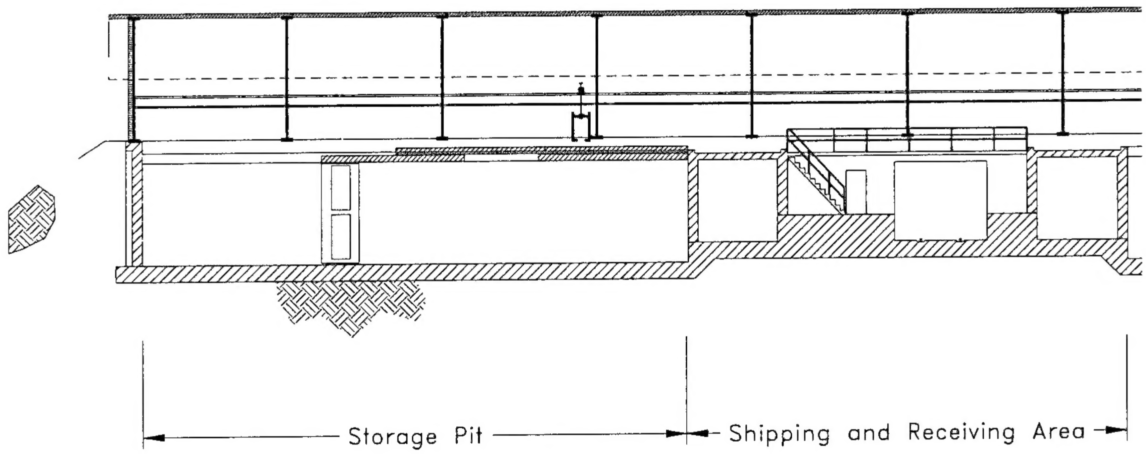


Figure 6-1g. Pit Cover Operating Locations, Open Position No. 6.

8.0 PHYSICAL SECURITY

Physical Security requirements are being evaluated by NFESC, Code ESC66 (Security Engineering Division). It is expected that the pit covers and crane will require high security locks to obtain proper denial times to the stored ordnance. Security for stored ordnance is mainly provided by the earth-bermed external magazine walls and the pit covers. Denial time may also need to be enhanced with an intrusion detection system that detects initial entry to the inside of the magazine.

The SRA will be considered as a barricaded siding when/if ordnance is stored overnight on a conveyance vehicle. A special high security lock (as is required on a standard box magazine door) will not therefore be required on the HP Magazine SRA vehicle door.

9.0 REFERENCES

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